M. Fréchet: "Sur les fonctionnelles bilinéaires."
D. F. Barrow: "Oriented circles in space."
D. Buchanan: "A new isosceles triangle solution of the three-body problem."
L. P. Eisenhart: "Surfaces Ω and their transformations."
E. J. Wilczynski: "The general theory of congruences."
J. H. M. Wedderburn: "On matrices whose coefficients are functions of a single variable."
E. Kasner: "Conformal classification of analytic arcs or elements: Poincaré's local problem of conformal geometry."
D. R. Curtiss: "Extensions of Descartes' rule of signs connected with a problem suggested by Laguerre."
J. B. Shaw: "On parastrophic algebras."

THE concluding (July) number of Vol. 21 of the *Bulletin of the American Mathematical Society* contains: Report of the April meeting of the society in New York, by F. N. Cole; "An elementary double inequality for the roots of an algebraic equation having greatest absolute value," by G. D. Birkhoff; "Certain non-enumerable sets of infinite permutations," by A. B. Frizell; "George William Hill, 1838–1914," by E. W. Brown; Review of Dickson's Linear Algebras, by W. C. Graustein; "Shorter Notices": Poincaré's Wissenschaft und Methode, by J. B. Shaw; Martin's Text-book of Mechanics, Vol. 5, by F. L. Griffin; "Notes"; "New Publications"; Twenty-fourth Annual List of Published Papers; Index of Volume 21.

SPECIAL ARTICLES

THE THEORY OF MAGNETIZATION BY ROTATION

THE experiment which I described in a recent number of this journal may be considered as a modification of an experiment made long ago by Maxwell,[1] who appears to have been the first to conceive the idea that a magnet should behave like a gyrostat if its Ampèreian currents are actually *material,* as modern theory assumes. In Maxwell's experiment an electromagnet, mounted in a frame in such a way as to be free to move about a horizontal line through its center of mass and perpendicular to its magnetic axis, was rotated at high speed about a vertical line, and optical observations were made to see whether the angle α between the vertical and the magnetic axis was altered as the speed increased from zero, stability being secured by properly adjusting the moments of inertia. No change in α was observed, but only rough experiments were possible.

[1] *Elec. and Mag.*, § 575.

In my experiment the electromagnet is replaced by each of the countless multitude of molecular magnets of which the iron rod is constituted, and the total change in the orientation of all the magnets with reference to the axis of rotation of the rod is determined magnetically instead of optically.

In the complete paper it is shown that the angular momentum M of the simplest type of molecular magnet possible, constituted of a negative electron with mass m and charge e revolving with angular velocity ω in a circular orbit about a positive nucleus with charge $-e$ at rest, is related to the magnetic moment μ by the equation

$$M = 2(m/e)\mu. \qquad (1)$$

If now the rod of which the molecular magnet is a part is set into rotation about its axis AB, with angular velocity Ω, the angle α between the vector M and AB will *decrease,* just as in the case of a gyroscope, until the torque T' on the system brought into existence by this displacement is just equal to the rate of increase of its total angular momentum in the steady state when kinetic equilibrium has been reached and the vector M is tracing out a conical surface with constant semi-angle α and angular velocity Ω. The effect in this steady state is exactly the same as if the rod were at rest and the molecular magnet were acted upon by a torque $T'' = -T'$ due to an extraneous magnetic field of strength H, where H is the intrinsic magnetic intensity of rotation. The complete expression for the torque T'' is known (and can readily be shown from first principles) to be

$$T'' = -T' = -M\Omega \sin \alpha - B\Omega^2 \sin \alpha \cos \alpha, \quad (2)$$

where B denotes the difference between the

two principal moments of inertia of the orbital system. In the case under consideration $B = M/2\omega$. Eliminating B and M from (2) we get

$$T'' = -\mu \sin \alpha \cdot 2 \frac{m}{e} \left(1 + \frac{1}{2} \frac{\Omega}{\omega} \cos \alpha \right).^{2} \quad (3)$$

If we divide this expression by $-\mu \sin \alpha$ we shall, as in the case of an ordinary magnetic field, get the intensity sought, viz.,

$$H = 2 \frac{m}{e} \Omega \left(1 + \frac{1}{2} \frac{\Omega}{\omega} \cos \alpha \right).^{3} \quad (4)$$

The magnitudes of Ω experimentally attainable are so small in comparison with ω that the second term is always negligible.

If we assume that e/m has the value (-1.77×10^7) ordinarily accepted for the negative electron in slow motion, and put $\Omega = 2\pi n$ where n is the speed of the rod in revolutions per second, we get for the intensity per unit speed

$$H/n = -7.1 \times 10^{-7} \frac{\text{gauss}}{\text{r.p.s}}. \quad (5)$$

This is the *maximum* magnitude possible; if some or all of the positive ions also have orbital motion, H will be smaller in magnitude than indicated by (4), but will still be proportional to Ω. The experimental value of H/n was, within the accidental error, one half that given by (5).

S. J. Barnett
The Ohio State University

[2] This equation also follows immediately from Maxwell's equation by putting in the conditions here assumed.

[3] The first term of this equation has been given previously, by Einstein and de Haas, but was obtained incorrectly, equations for a *molar* magnet instead of a *molecular* magnet being employed.

THE TRANSMISSION OF POTATO MOSAIC THROUGH THE TUBER

Mosaic of the potato is very prevalent in Bermuda on the Bliss Triumph and is the cause of serious losses to the growers, as the yield of affected plants is reduced from 10 to 75 per cent., and often a field will have a large proportion of plants with this disease.

An inspection made in July, 1914, of the fields on Long Island in which stock was being grown for shipment to Bermuda for seed purposes showed the almost general presence of mosaic on the Bliss Triumph. The same condition existed in many fields of Bliss Triumph in Maine, where the stock for Long Island is obtained. These general facts strongly indicated that the mosaic of potatoes was transmitted by the tubers, in the first case from Maine to Long Island and in the second generation from Long Island to Bermuda.

There was, however, no evidence in the literature on potato growing to support this view. Dr. W. A. Orton, in Bulletin 64 of the United States Department of Agriculture, on "Potato Wilt Leaf Roll and Allied Diseases," writes, "it is not improbable that mosaic is transmitted by the tubers" adding, however, that no experiments had been undertaken that had conclusively proved this. Experiments were consequently conducted at the agricultural station in Bermuda with a view to securing definite information on this point.

Through the courtesy of Drs. I. E. Melhus and L. O. Kunkel, of the Bureau of Plant Industry of Washington, tubers from selected hills of healthy and mosaic parents were obtained from a field at Van Buren, Maine, that was visited by the writer in September, 1914.

The tubers obtained from Van Buren were planted in Bermuda in November, 1914, in duplicate rows, and the result showed in a striking manner in January, 1915, that the mosaic of potatoes is transmitted through the planting of tubers from mosaic parents:

No. of Plants	Tubes Selected from	Percentage of Mosaic Plants
A. 200	Healthy parents	nil (4 or 5 doubtful)
B. 200	Stock on the market	80
C. 200	Mosaic parents	100

The yield from the plants affected with mosaic was less than half that of the healthy stock.

Mosaic of the potato is undoubtedly one of the serious potato problems that have escaped the notice of the practical farmer and that have until recently received little attention from scientific workers. To growers of the